THE ITHOMIINES OF BRAZIL (LEPIDOPTERA: NYMPHALIDAE). III. REDISCOVERY AND SYSTEMATIC POSITION OF *NAPEOGENES XANTHONE*.[1]

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ABSTRACT: The Ithomiines of Brazil (Lepidoptera: Nymphalidae). III. Rediscovery and systematic position of *Napeogenes xanthone*. Abstract. - The "lost" east Brazilian butterfly species *Napeogenes xanthone* Bates was recently rediscovered in Itamaraju, in the south of the state of Bahia, where it occurs very rarely in large ithomiine pockets also occupied by much greater numbers of the very similar *Hypothyris euclea laphria*. Morphological considerations indicate it to be conspecific with *Napeogenes yanetta* Hewitson, which occurs locally farther south in the states of Espirito Santo and Rio de Janeiro; *xanthone* takes date preference for the name of the combined species. The variable form "richardi" Fruhstorfer represents a clinal series between *N.x. xanthone* and *N.x. yanetta*, found principally in northern Espirito Santo and adjacent eastern Minas Gerais. The recently described form "haenschi" Fox and Real is regarded as an intrapopulational variant of *N.x. yanetta*, though it may be seasonally predominant in local areas southward. The relationships of *N. xanthone* to the Amazonian *N. inachia* and *N. cyrianassa* are uncertain, but are surely much more distant than that to *N.x. yanetta*. The ambiguous name *Mechanitis rhezia* Geyer should be regarded as a "species inquerenda".

DESCRIPTORS: Lepidoptera; Nymphalidae; Ithomiinae; *Napeogenes xanthone; Napeogenes yanetta; Napeogenes inachia; Napeogenes cyrianassa;* rare "Bahia-species" from eastern Brazil; ecology; zoogeography; polymorphism; integradation; mimicry; mechanisms of extinction of forest insects.

I. HISTORICAL BACKGROUND

The rich endemic entomological fauna of southern Bahia, in eastern Brazil, was originally discovered by naturalists working out from boats docked in the port of Ilheus. The forms were mostly described in the last century, but many have had little contact since their descriptions with the world of science. Ecological changes wrought in this area by man and nature, coupled with the general inaccessibility of the region until the late 1960's and its reputation as

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a seedbed of malaria and schistosomiasis, turned many of the classical "Bahia species" into riddles and stumbling-blocks for modern taxonomists. The few ancient museum specimens available were often insufficient to resolve even fundamental questions of morphology and systematic placement, and obviously could not lend themselves to studies of karyology, ethology, juvenile biology, or ecological and population parameters.

Such was the case with *Heliconius nattereri* Felder 1865, a key primitive member of its genus which was finally rediscovered in 1967, by Claudionor Elias of the Universidade Federal do Parana, at the southern extreme of its range in central Espirito Santo (Brown, 1970). The narrow ecological specialization of this butterfly to large tracts of steep, humid forest, and usually fatal competition against the larvae on the unique, slow-growing forest foodplant by more abundant and aggressive heliconians which have multiplied greatly in clearings made by man, have driven it near to natural extinction. The conditions needed for survival of a colony are rarely found in Bahia or Espirito Santo today, and the few remaining tracts are rapidly disappearing due to indisciminate destruction by unchecked agricultural and timber interests (Brown, 1970, 1972).

The uniquely dimorphic and mimetic female of *H. nattereri* closely resembles another "lost" species described from Bahia in the same decade, *Napeogenes xanthone* Bates, 1862. There appears to exist only a single short series of this form (four males and a female, including the holotype) in the British Museum (Natural History); no specimens are available in collections in the western hemisphere, and there seem to be none in European mainland collections. Its systematic position is at present unresolved.

A specimen of *xanthone* from the Bates collection (but not the holotype) was figured by d'Almeida (1960, fig. 7-3; reproduced in Figure 1). He discussed the difference between true *xanthone* and a different, south Brazilian species to which the name was usually applied, properly called *Napeogenes yanetta* (Hewitson, 1867) (Figure 2). d'Almeida also figured a form named *richardi* by Fruhstorfer (1898), found in eastern Minas Gerais; he regarded this as a further good species, since the yellow forewing postmedian band invaded the black costal margin, a condition which d'Almeida claimed was never seen in specimens of *yanetta.*

The holotype of *xanthone,* very similar to the specimen examined by d'Almeida, was figured by Fox and Real (1971) in their revision of the tribe Napeogenini. These authors admitted that the status of this form was still uncertain, but on the basis of color-pattern homologies, they placed it with the Amazonian *N. inachia* (Hewitson, 1855) (Figure 3). Fruhstorfer's *richardi* was regarded as a subspecies of *yanetta,* and the latter was further divided to give a new southern subspecies *N.y. haenschi* Fox and Real, 1971. The

richardi figured by these authors, from the Munich collection (Zoologisches Sammlung des Bayerischen Staates), is not very similar to the one photographed by d'Almeida, from the Museum National d'Histoire Naturelle in Paris (on loan to the Museu Nacional, Rio de Janeiro). Both specimens are probably part of Fruhstorfer's original type-series, but that figured by Fox and Real represents a transition between d'Almeida's conception of this name and typical *N. y. yanetta.*

N.y. haenschi must be regarded as a synonym of *yanetta.* Both forms occur commonly in all known populations of this rather plastic species, although the sample taken at the type locality of *haenschi* may have been more uniform on the collecting date; other samples from the area are typical *yanetta* (Figure 4).

The wide range of variation in the appearance of *richardi* (Figure 5), and its occurrence in central Espirito Santo and northeastern Minas Gerais, strongly suggest that it could represent a cline between *yanetta* and the Bahian *xanthone.* Unfortunately, the holotype of *xanthone,* dissected by Fox, bore a false abdomen (probably from *Hypothyris euclea laphria*), so the morphological affinities of this form could not be established in the revision of Fox and Real. As the use of color-pattern homologies is notoriously dangerous in the taxonomy of the mimetic Ithomiinae, it seemed necessary to obtain fresh specimens of the lost *xanthone,* in order to determine its correct systematic position.

II. REDISCOVERY

The many excursions into northern Espirito Santo and southern Bahia during the *nattereri* project failed to reveal the presence of any *xanthone* in the woods of this region. The very similar *Hypothyris euclea laphria* was abundant in the area, and rapidly saturated a collector's interest, however, so *xanthone* could have easily passed unnoticed in this crowd. The closely related *Napeogenes sulphurina* was always present and frequently common in the forest areas visited. From central Espirito Santo southward, *N. yanetta* was found very sparsely, with northerly populations often including many *richardi*-like individuals (Figure 6).

The necessary elements for the rediscovery of *xanthone* converged in January 1972. Claudionor Elias, now stationed in Linhares (see Map) and his son Paulo Cesar were exploring a new road, BR-101 (now a modern paved highway, but then an unimproved and often-interrupted track) in southern Bahia. Submersion of their Jeep station wagon up to the windshield in an unexpectedly deep waterhole in a detour, caused a forced stay of several days

in Itamaraju, at the base of some scenic granite hills well inland from the sea (Map), in an area where some wise landowners had preserved much forest. Paulo Cesar had the uninspiring task of collecting abundant ithomiines in quantity for this author's chemical investigations, so he set to work in a large nearby woods trying to place some dents in the hordes of *laphria* flying about. These butterflies were enveloped, boxed, and sent down to Rio de Janeiro in July.

This lot, from a previously unsampled area, was preliminarily analyzed for species ratios and the possible presence of aberrations or unusual forms, before being crammed into envelopes destined for the Waring blendor. Among large numbers of *laphria, N. sulphurina, Pteronymia euritea, Ceratiscada canaria* (see Brown and d'Almeida, 1970), *Oleria ?thiemei,* and a new subspecies of *Ithomia lichyi* (to be described in a forthcoming part of this series), two rather strange-looking mimetic male ithomiines came to light. Both lacked the discal forewing black marks of *laphria* and looked generally "cleaner" than this form. One could be assigned as an extreme specimen of *Napeogenes yanetta richardi,* near the original description but even more heavily overprinted with orange on the forewing. The other was identical with d'Almeida's figure of *Napeogenes xanthone.*

Thus, once again Claudionor Elias figured in the relocation of a lost "Bahia species". He was instructed immediately as to the identifying characteristics of *xanthone,* and urged to return to Itamaraju as soon as road conditions permitted.

Figures 1-7: *Napeogenes* adults, slightly less than life size; black, yellow, and orange. Fig. 1, *N. xanthone,* Bates collection, British Museum (Natural History), reproduced from d'Almeida (1960). Fig. 2, *N.x. yanetta*, reproduced from type-figure in Hewitson (1867). Fig. 3, *N.i. inachia*, Ourem, Para, O. Mielke leg., Museu Nacional, Rio de Janeiro; note greater transparency than in *xanthone*. Fig. 4, *N. xanthone yanetta*, form "haenschi", topotype (from series of the holotype), Angra dos Reis, Rio de Janeiro (upper); typical *N.x. yanetta*, Tingua, Rio de Janeiro, near Angra dos Reis (second); and four examples of *N.x. yanetta* from Colatina, Espirito Santo, including "haenschi" and transitions to "richardi"; all in the Museu Nacional. Fig. 5, six examples of form "richardi" and transitions thereto from both subspecies: upper two, syntypes of Fruhstorfer (second specimen also illustrated by d'Almeida, 1960, and corresponding to his idea of the form), eastern Minas Gerais, Museu Nacional (on loan from the Museum National d'Histoire Naturelle, Paris); middle two, recent specimens from Santa Teresa, Espirito Santo, in the central highlands, upper with hindwing of *xanthone*, lower with full yellow forewing postmedian band as in *xanthone* but no orange coloration (collection of the author); lower two, "richardi"-like specimens from the recently discovered *xanthone* colony, Itamaraju, Bahia (collection of the author). Fig. 6, six specimens of *N.x. yanetta* from Linhares, central Espirito Santo (coastal lowlands), showing transitional forms from *yanetta* towards *xanthone* (upper two in Museu Nacional, the second from near Nova Venezia northwest of Linhares; other four in author's collection). Fig. 7, six specimens from the rediscovered colony of *N.x. xanthone*, Itamaraju, Bahia, 1972-73; lower a female, others males; fifth ventral (collection of the author).


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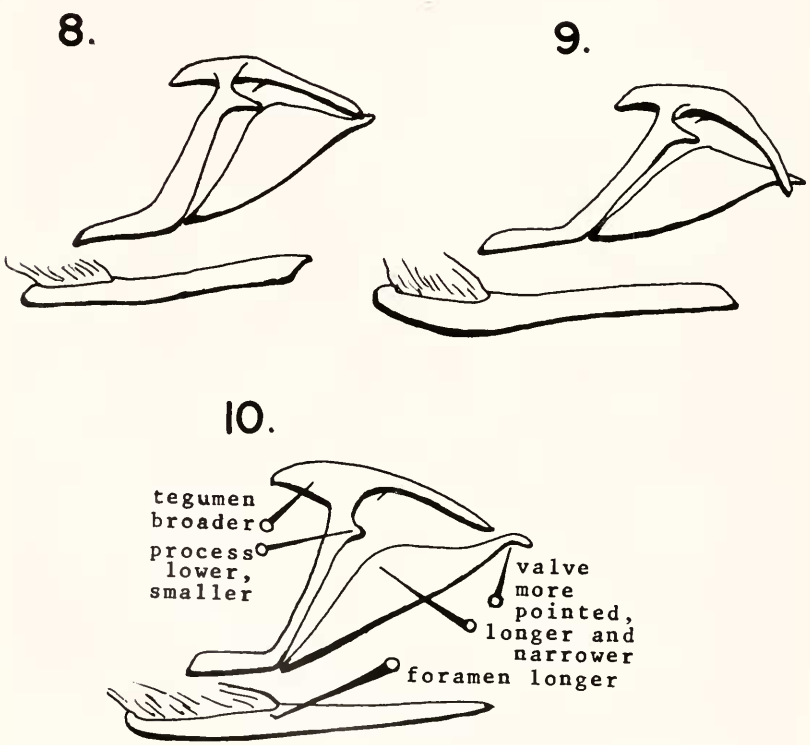
The next opportunity came in April 1973, when a single day was spent with Claudionor in the same woods, now on the edge of a high-speed road and but a few hours' drive from Linhares. Ithomiines in general were exceedingly scarce, and even with *Heliotropium* bait it was difficult to turn up a few *laphria* and other usually abundant species.

As the fall and winter ithomiine season came into full swing, Claudionor revisited Itamaraju in July and thoroughly explored another woods to the south of town. In two widely separated ithomiine pockets, he captured another three males of *xanthone;* once again, one of these was somewhat transitional to *richardi.*



Figures 8-10: *Napeogenes*, schematic left aspect of sclerotized male genital armatures, left valve removed, penis figured beneath. Fig. 8, *N.x. xanthone*, Itamaraju, Bahia, January 1972. Fig. 9, *N.x. yanetta*, Corrego do Sabia, Nova Venezia, Espirito Santo (Museu Nacional). Fig. 10, *N.i. inachia*, Ourem, Para (Museu Nacional).

Finally, two full days in these same pockets (September 1-2, 1973) in the company of Claudionor and using much *Heliotropium,* produced for the author a short series (two males and six females) of this unusual form, confirming its regular presence in the Itamaraju area.

A selection of the thirteen specimens from Itamaraju is illustrated in Figure 7; two *richardi*-like individuals (of the four, representing 30% of the sample) are included in Figure 5. One typical pair has been donated to the Museu Nacional, Rio de Janeiro; the others are presently retained in the author's collection.

III. SYSTEMATICS

Although a reasonably complete morphological study of the now available *xanthone* was projected, in order to clarify its taxonomic position, this proved unnecessary. The clear intergradation to *yanetta* through the variable forms of *richardi* strongly indicated conspecificity (Figures 5 and 6). The male genitalia of *xanthone* (Figure 8) are essentially identical with those of *N. yanetta* (Figure 9), and sufficiently distinct from those of Para *N. inachia* (Figure 10) to permit the association of *xanthone* with the former (taking name preference over it) and its divorce from the latter. Its close relationship with *inachia* and perhaps even closer relationship (in both color-pattern and genitalia) with *N. cyrianassa* are indisputable, however. In spite of long and very complete geographic separation of *xanthone* from these common Amazonian species (at least since the breakup of the last major forest connection across northeastern and central Brazil to south Bahia), it may still prove to be interfertile with one of them. Until appropriate tests can be made in the insectary, however, it seems best to maintain *Napeogenes xanthone* and its southern subspecies *N.x. yanetta* as a separate species, like the majority of other ithomiine forms endemic to southern Bahia which show affinities with Amazonian relatives. The highly variable form "richardi", regarded as a cline between *xanthone* and *yanetta,* is normally found in northern Espirito Santo and adjacent Minas Gerais, but may be expected occasionally well into typical populations of *yanetta* as far south as southern Espirito Santo, and of *xanthone* well north into Bahia.

The relationships of the various taxa are indicated in the following key.

1. a. Orange coloration on the dorsal hindwing absent or confined to the anal submarginal region (central Espirito Santo to southern Rio de Janeiro) . . . . . *yanetta*
   i. Orange color on forewing restricted to behind the anal vein . . form *yanetta*
   ii. Orange color on the forewing invading the discal cell . . . . . form "haenschi"
   b. Orange color on the dorsal hindwing forming a complete submarginal band from the anal margin to the apex (Bahia, eastern Minas Gerais, Espirito Santo) . . . . . *xanthone*
   i. Forewing basal area orange to a heavy postmedian black bar, and yellow stripe beyond this essentially contiguous with the black apex . . . . . form *xanthone*
   ii. Forewing basal area orange mixed with yellow (the latter often predominant), and postmedian yellow bar separated from black apex by a transparent area . . . . . form "richardi"

Both d'Almeida (1960) and Fox and Real (1971) mention the close correspondence of *xanthone* with Geyer's figures (1834) of *Mechanites* [sic] *rhezia,* but both conclude that the two are not identical. Ignoring obvious errors in drawing, the figures of *rhezia* are indeed extremely similar to *xanthone.* However, they could equally well apply to some, especially Guianan, forms of *Napeogenes cyrianassa.* In view of this ambiguity and in the absence of the types, it might be best to regard *rhezia* as a "species inquerenda", so that it does not introduce further confusion into the usage of the well-established names for the two species it may represent.

IV. ECOLOGICAL NOTES

N. xanthone, like many members of its genus (but not the sympatric *N. sulphurina*), is both extremely local and very sparse in occurrence. The ratio of *Hypothyris euclea laphria* to *N. xanthone* in the Itamaraju forests is several hundred to one; the odds of encountering *xanthone* among the *laphria* are not increased by the use of *Heliotropium,* to which both are strongly attracted, but this dried plant does make the individuals sit down where they can be better identified with binoculars. *Xanthone* is a very wary and relatively high-flying species, and leaves *Heliotropium* quickly when any danger threatens within five meters; it returns in a few minutes if the disturbance is removed, however. More individuals were captured flying high through the dark shady woods, especially in mid-afternoon, than on the bait. All were found in central areas of large ithomiine pockets (dark, humid, but relatively open undergrowth areas in heavy forest), to which *N.x. yanetta* has also been observed to be closely restricted.

No information was obtained on the early stages or the foodplant of *xanthone;* eggs expressed from the females did not hatch. Females of *N. inachia johnsoni* (Meta, Colombia) and *N. sulphurina* (Pernambuco) have been observed to swarm around the solanaceous foodplants and lay eggs for only a short period of their lives, apparently ignoring it most of the time. Thus, the study of the juvenile biology of *xanthone* may have to await a fortunate observation of such an "oviposition dance".

Sympatric ithomiines in the two pockets observed, in addition to the six common species mentioned above, include *Tithorea harmonia pseudethra, Melinaea ludovica paraiya, Melinaea ethra, Thyridia psidii hippodamia*[3], *Mechanitis lysimnia lysimnia* and (much rarer) *I. nesaea, Mechanitis polymnia casabranca, Scada karschina, Hypothyris daeta daeta, Oleria aquata, Aeria olena olena, Callithomia xantho,* and *Prittwitzia hymenaea hymenaea.*

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[3]This nomenclature is based on the Doctor's thesis of Gerardo Lamas Muller, Universidade de Sao Paulo (Museu de Zoologia), December 1973.

V. THE FUTURE

The Itamaraju woods is essentially contiguous with the large and ecologically identical forest preserve of the Parque Nacional de Monte Pascoal (Map). This fact would seem to guarantee that *xanthone* will continue to be present, even though rare, in the area for the foreseeable future. However, as no other colonies have been located in recent work in southern Bahia, the subspecies must continue to be regarded as possessing a fragile existence on the modern scene. The confinement of this species to scattered large "ithomiine pockets" probably indicates specialization both in choice and in utilization of a unique foodplant. This in turn may be sparsely distributed for

ecological reasons, or perhaps frequently preoccupied by other more common ithomiines (this was the case with the unique foodplant of *Heliconius nattereri,* the other very rare and probably rapidly disappearing "Bahia species" mentioned above). If a similar situation be present in *xanthone,* local colonies may be expected to be easily eliminated, not only by direct interference with plant cover or soil conditions in the immediate area, but also by nearby cutting which could promote multiplication of more adaptable competitors on common disturbed-forest species of Solanaceae.

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